HELICOPTER-BORNE GEOPHYSICAL SURVEY UTILISING THE VERSATILE TIME DOMAIN ELECTROMAGNETIC SYSTEM (VTEM)

For

IMX Resources NL
(IMX)

Tasmania Project Areas
Tasmania

Survey flown March, 2008

Project A337
April, 2008

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REPORT ON A HELICOPTER-BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC SURVEY

Tasmania Project Areas, Tasmania

Executive Summary

During the period March 5th to March 11th, 2008, Geotech Airborne Pty Ltd conducted a helicopter-borne geophysical survey for IMX Resources NL over four blocks centrally located approximately 115 km west-north-west of Devonport, Tasmania.

Principal geophysical sensors included a versatile time domain electromagnetic (VTEM) system and a cesium magnetometer. Ancillary equipment included a GPS navigation system and a radar altimeter. A total of 620.6 line-km were flown.

A combination of Perth based and in-field data processing was utilised throughout the operation. This involved quality control and data compilation during the acquisition stage. Final data processing, including generation of final digital data products, was finalised and undertaken by the Perth processing department.

The final processed survey results are presented as:

- Colour Magnetic Contour (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)
- dB/dt EM Profile Maps at a logarithmic scale (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)
- Color Digital Elevation Model Contour (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)
- Flight Path (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)
- Processed Digital Data (databases in Geosoft Montaj GDB format)
- Operational Report (digital – PDF document)

Digital data includes all electromagnetic and magnetic products plus positional, altitude and raw data.

1. INTRODUCTION

1.1 General Considerations

These services are the result of the Agreement made between Geotech Airborne Pty Ltd and IMX Resources NL, to perform a helicopter-borne geophysical survey over their Tasmanian Project areas. The blocks are centrally located approximately 115 km west-north-west of Devonport, Tasmania.

620.6 line-km of geophysical data were acquired during the survey.

Paul Mutton acted on behalf of IMX during the data acquisition and processing phases of this project.

The survey blocks are shown in Appendix A.

Throughout the project's duration, the crew was based at The Bridge Hotel, Smithton, Tasmania.

The acquisition phase of the survey is depicted in Section 2 of this report.

The helicopter was based at Smithton Airport throughout the duration of the survey.

Survey flying was completed on March 11th, 2008 with preliminary data processing carried out on a daily basis during the acquisition phase of the project.

Final data presentation and data archiving was completed at the Perth Geotech Office, April 2008.

1.2. Survey and System Specifications

The Survey was flown over the period March 5th to March 11th and flown at a nominal traverse line spacing of 200 metres. Traverse lines directions for the four blocks are shown in section 2.1, table 1. No tie lines were.

Where possible, the helicopter maintained a mean terrain clearance of 80 metres, which translated into an average height of 30 metres above ground level for the bird-mounted VTEM system and 65 metres above ground level for the magnetic sensor.

The survey was flown using a Eurocopter AS350B3 registration VH-IPW, operated by United Aero Helicopters. Details of the survey specifications may be found in Section 2 of this report.

1.3. Data Processing and Final Products

Data compilation and processing were carried out by the application of Geosoft OASIS Montaj and programs proprietary to Geotech Airborne Pty Ltd.

Final products including databases, grids and maps were presented to IMX.

The survey report describes the procedures for data acquisition, processing, final image presentation and the specifications for the digital data set.

1.4. Topographic Relief

The survey blocks are centrally located approximately 115 km west-north-west of Devonport, Tasmania.

Topographically, the blocks exhibit a moderate relief, with an elevation range from 2.5 metres (block 2) to 225.5 metres (block 4) above sea level.

2. DATA ACQUISITION

2.1. *Survey Area*

The survey block (see location map, Appendix A) and general flight specifications are as follows:

Survey block	Line spacing (m)	Tie Line spacing (m)	Line-km	Flight direction	Line number
A337 Block 1	200	N/A	422.5	056-236	L10010-10810, 50010-50020
A337 Block 2	200	N/A	47.8	090-270	L20012-20160
A337 Block 3	200	N/A	84.1	120-300	L30010-30220, 50030-50080
A337 Block 4	200	N/A	66.1	120-300	L40012-40220

Table 1 - Survey blocks

Survey block boundary co-ordinates are provided in Appendix B.

2.2. *Survey Operations*

Survey operations were based from Smithton, Tasmania.

The following charts show the timing of production for the project.

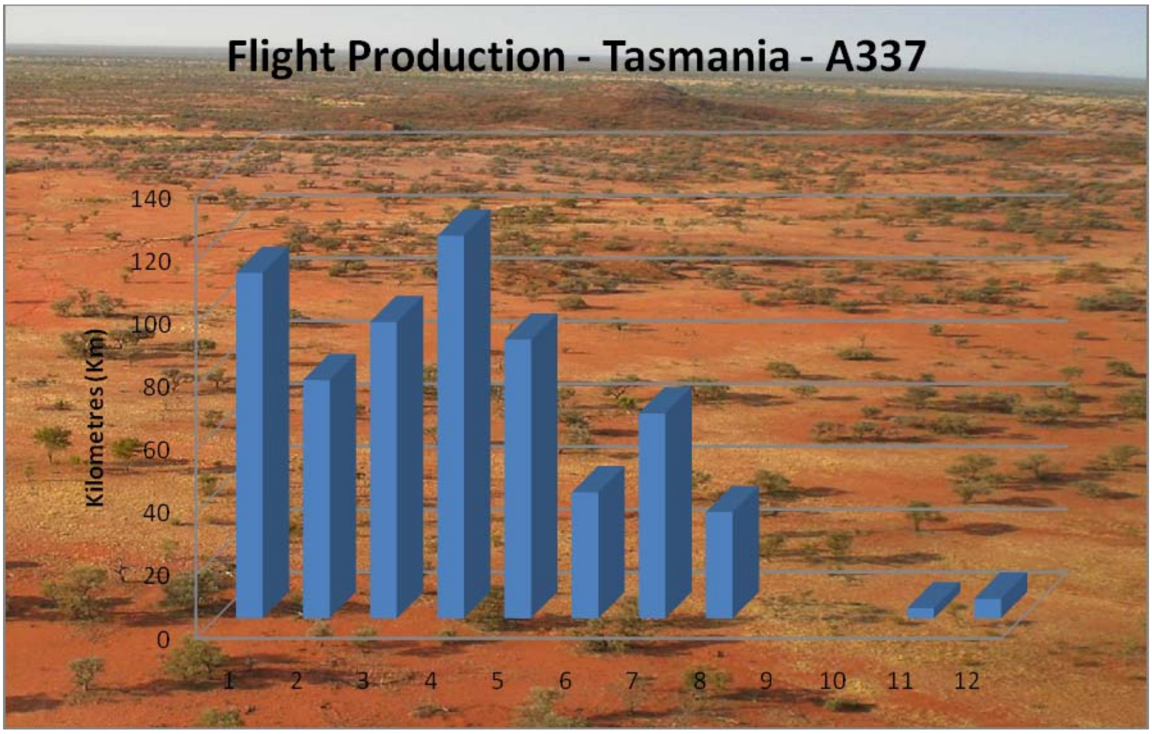


Chart 1 – Flight Production

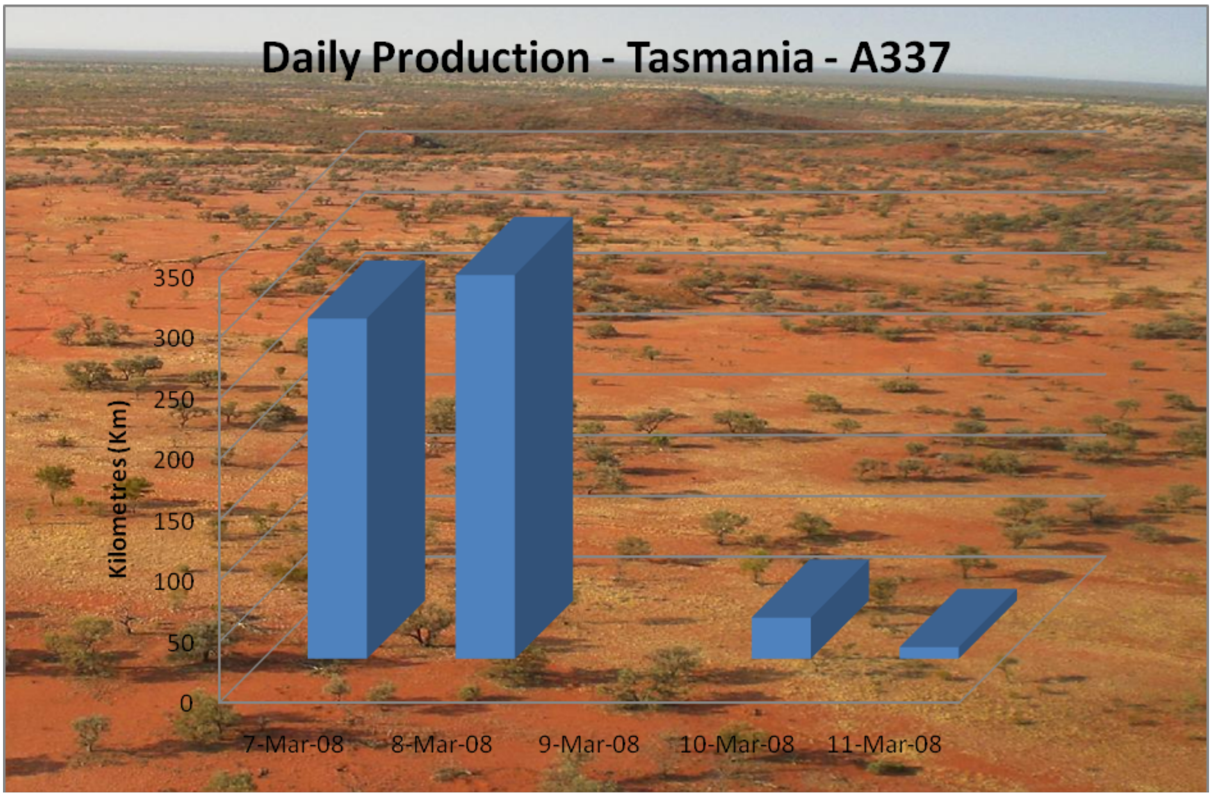


Chart 2 – Daily Production

2.3. Flight Specifications

The nominal EM sensor terrain clearance was 30 m (EM bird height above ground level, i.e. helicopter is maintained 80 m above ground level). Nominal survey speed was 80 km/hour. The data recording rates of the data acquisition system were 0.1 seconds for electromagnetic and magnetic data, 0.2 seconds for altitude and GPS data. This translates to a geophysical reading approximately every 2 metres along the flight track. Navigation was assisted by a GPS receiver and data acquisition system, which reports GPS co-ordinates as latitude/longitude and directs the pilot over a pre-programmed survey grid.

The operator was responsible for monitoring the system integrity and also maintained a detailed flight log during the survey, tracking the times of the flight as well as any unusual geophysical or topographic features.

On return of the aircrew to the base camp the survey data was transferred from a compact flash card (PCMCIA) to the data processing computer.

2.4. *Aircraft and Equipment*

2.4.1. Survey Aircraft

A Eurocopter AS350B3 registration VH-IPW - owned and operated by United Aero Helicopters was utilised for the survey. Installation of the geophysical and ancillary equipment was carried out by Geotech Airborne Pty Ltd.

2.4.2. Electromagnetic System

The electromagnetic system was a Geotech Time Domain EM (VTEM) system. The configuration is as indicated in Figure 1 below.

The system operates with a trapezoidal wave form and records measurements at 10 samples a second.

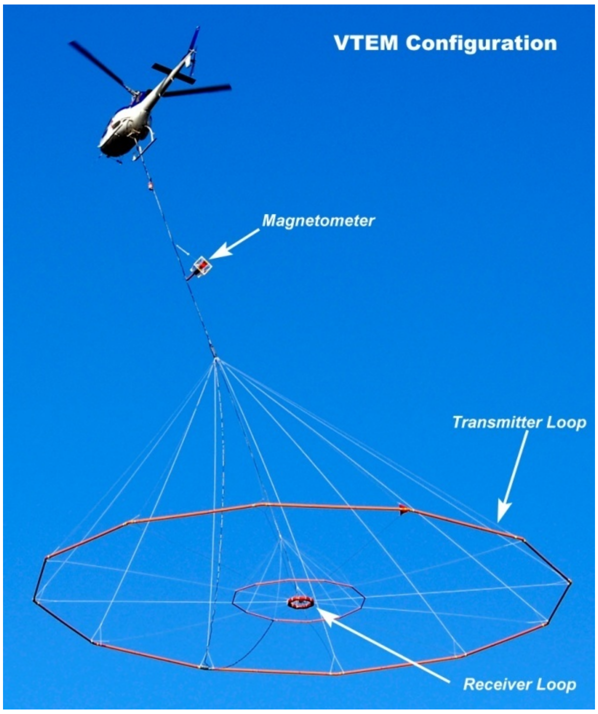


Figure 1 – VTEM configuration

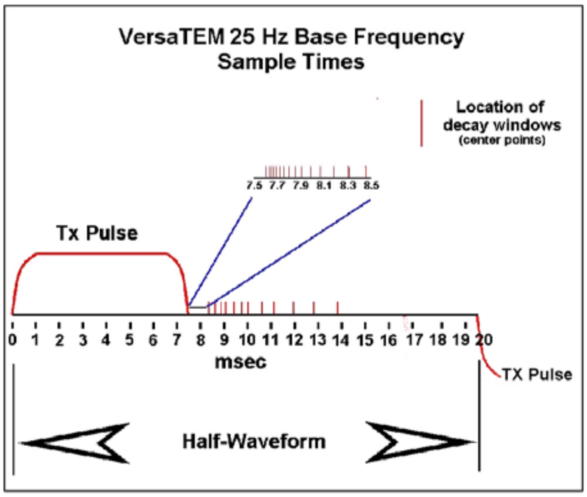


Figure 2 – sample times

Receiver and transmitter coils are concentric and Z-direction oriented.

The receiver decay recording scheme is shown diagrammatically in Figure 2.

Data was sampled over twenty-seven time gates in the range 99 µs to 9245 µs, as shown in Table 2.

VTEM Decay Sampling scheme				
Array	(Microseconds)			
Index	Time Gate	Start	End	Width
9	99	91	110	19
10	120	110	131	21
11	141	131	154	24
12	167	154	183	29
13	198	183	216	34
14	234	216	258	42
15	281	258	310	53
16	339	310	373	63
17	406	373	445	73
18	484	445	529	84
19	573	529	628	99
20	682	628	750	123
21	818	750	896	146
22	974	896	1063	167
23	1151	1063	1261	198
24	1370	1261	1506	245
25	1641	1506	1797	292
26	1953	1797	2130	333
27	2307	2130	2526	396
28	2745	2526	3016	490
29	3286	3016	3599	583

30	3911	3599	4266	667
31	4620	4266	5058	792
32	5495	5058	6037	979
33	6578	6037	7203	1167
34	7828	7203	8537	1334
35	9245	8537	10120	1584

Table 2 - VTEM decay sampling scheme

Transmitter coil diameter was 26 metres; the number of turns was 4.
Transmitter pulse repetition rate was 25 Hz.
Peak current was 200 Amp.
Duty cycle was 37.3%.
Peak dipole moment was 424,528 NIA; with a pulse width of 7.46 ms

Receiver coil diameter was 1.2 metres; the number of turns was 100.
Receiver effective area was 113.1 m^2
Wave form – trapezoid.
Recording sampling rate was 10 samples per second.
The EM bird was towed 42 m below the helicopter.

2.4.3. Airborne magnetometer

The magnetic sensor utilised for the survey was a Geometrics optically pumped caesium vapour magnetic field sensor, mounted behind the EM receiver loop, towed 12 m below the helicopter, as shown in Figure 1. The sensitivity of the magnetic sensor is 0.02 nano Teslas (nT) at a sampling interval of 0.1 seconds. The magnetometer sends the measured magnetic field strength as nano Teslas to the data acquisition system via the RS-232 port.

2.4.4. Ancillary Systems

2.4.4.1. Radar Altimeter

A Terra TRA 3000/TRI 40 radar altimeter was used to record terrain clearance. The antenna was mounted beneath the bubble of the helicopter cockpit.

2.4.4.2. GPS Navigation System

The navigation system used was a Geotech PC based navigation system utilising a NovAtel WAAS enabled OEM4-G2-3151W GPS receiver, Geotech navigate software, a full screen display with controls in front of the pilot to direct the flight and a NovAtel GPS antenna mounted on the helicopter tail.

The co-ordinates of the block were set-up prior to the survey and the information was fed into the airborne navigation system.

2.4.4.3. Digital Acquisition System

A Geotech data acquisition system recorded the digital survey data on an internal compact flash card. Data is displayed on an LCD screen as traces to allow the operator to monitor the integrity of the system. The data type and sampling interval are provided in table 4.

DATA TYPE	SAMPLING
TDEM	0.1 sec
Magnetometer	0.1 sec
GPS Position	0.2 sec
Radar Altimeter	0.2 sec

Table 2 - Sampling Rates

2.4.5. Base Station

A system of two Geometrics 856 Proton Precession base stations were utilised throughout the project for precautionary measures. Two magnetic sensors with a sensitivity of 0.1 nano Teslas recorded the local magnetic field strength. This base station data was then synchronised to the helicopter acquisition system to diurnally correct the magnetic data. The base station magnetometers were installed away from electric transmission lines and moving ferrous objects such as motor vehicles and fence lines. The magnetometer base station data was backed-up to the data processing computer at the end of each survey day.

3. PERSONNEL

The following Geotech Airborne Pty Ltd personnel were involved in the project.

Field
Operator / Crew chief: Dae Cho / Jason Callaghan

The survey pilot was employed directly by the helicopter operator – United Aero Helicopters.

Pilots: James McKinstry
Mechanical Engineer: United Aero Helicopters

Office
Data Processing / Reporting: Stephen Carter / Simon Bailey

Final data processing at the office of Geotech Airborne Pty Ltd in Perth, Australia was carried out under the supervision of Stephen Carter.

Overall management of the survey was carried out from the Johannesburg office of Geotech Airborne Ltd. by Keith Fisk, Managing Partner and Director.

4. DATA PROCESSING AND PRESENTATION

4.1. Flight Path

The flight path, recorded by the acquisition program as WGS84 latitude/longitude, was converted into the UTM coordinate system in Oasis Montaj.

The flight path was drawn using linear interpolation between x and y positions from the navigation system. Positions are updated every second and expressed as UTM easting (x) and UTM northing (y).

4.2. Electromagnetic Data

A three stage digital filtering process was used to reject major spheric events and to reduce system noise. Local spheric activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major spheric events. The filter used was a 4 point non-linear filter.

The signal to noise ratio was further improved by the application of a low pass linear digital filter. This filter has zero phase-shift which prevents any lag or peak displacement from occurring and suppresses only variations with a wavelength less than about 1 second or 20 metres. This filter is a symmetrical 1 sec linear filter.

The results are presented as offset profiles of EM voltages for the gate times, in linear - logarithmic scale.

Generalized modelling results of the VTEM system, written by Geophysicist Roger Barlow, are shown in Appendix C.

Graphical representation of the VTEM output voltage of the receiver coil is depicted in Appendix D.

4.3. Magnetic Data

The processing of the magnetic data involved the correction for diurnal variations by using the digitally recorded ground base station magnetic values. The base station magnetometer data was edited and merged into the Geosoft GDB database on a daily basis. The aeromagnetic data was corrected for diurnal variations by subtracting the observed magnetic base station deviations.

Tie line levelling was carried out by adjusting intersection points along the traverse lines. A micro-levelling procedure was then applied. This technique is designed to remove persistent low-amplitude components of flight-line noise remaining after tie line levelling.

The corrected magnetic data was interpolated between survey lines using a random point gridding method to yield x-y grid values for a standard grid cell size of approximately 0.2 cm at the mapping scale. The Minimum Curvature algorithm was used to interpolate values onto a rectangular regular spaced grid.

4.4. Digital Elevation Model

Subtracting the radar altimeter data from the GPS elevation data creates a digital elevation model. Linear artefacts are levelled by application of tie line levelling and micro-levelling techniques.

The final digital elevation model data is interpolated onto a 100 metres square grid using a minimum curvature gridding algorithm.

5. DELIVERABLES

5.1. Survey Report

The survey report describes the data acquisition, processing, and final presentation of the survey results.

The survey report is provided in two digital copies in PDF format.

5.2. Maps

Final maps were produced at a scale of 1:25,000. The coordinate/projection system used was WGS84, UTM zone 55 south.

The following maps were delivered to IMX in digital format as results of the helicopter-borne geophysical survey carried out over their Tasmanian tenements.

- Color Magnetic Contour (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)
- dB/dt EM Profile Maps at a logarithmic scale for all traverse survey lines (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)
- Color Digital Elevation Contour (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)
- Flight Path (digital – maps in Geosoft Montaj MAP & MapInfo TAB format)

5.3. Geophysical database

The following is provided to IMX in Geosoft GDB format.

- Processed Digital Data (database in Geosoft Montaj GDB format)

5.4. Digital Data

Two copies of DVD's were prepared.

There are two (2) main directories,

Data contains a database and maps, as described below.

Report contains a copy of the report and appendices in PDF format.

- Database in Geosoft GDB format, containing the following channels:

X:	X positional data (metres – WGS84, UTM Zone 55 South)
Y:	Y positional data (metres – WGS84, UTM Zone 55 South)
Lon:	Longitude data (degrees – WGS84)
Lat:	Latitude data (degrees – WGS84)
Z:	GPS antenna elevation (metres - ASL)
Gtime :	GPS time (seconds of the day)
Basemag:	Base magnetic diurnal variations (nT)
Radar:	Helicopter terrain clearance from radar altimeter (metres - AGL)
Radarb:	EM Transmitter and Receiver terrain clearance (metres - AGL)
DEM:	Digital elevation model (metres)
Mag1:	Raw Total Magnetic field data (nT)
Mag2:	Total Magnetic field diurnal variation corrected data (nT)
Mag3:	Levelled Total Magnetic field data (nT)
SF[9]:	dB/dt 99 microsecond time channel ($pV/A/m^4$)
SF[10]:	dB/dt 120 microsecond time channel ($pV/A/m^4$)
SF[11]:	dB/dt 141 microsecond time channel ($pV/A/m^4$)
SF[12]:	dB/dt 167 microsecond time channel ($pV/A/m^4$)
SF[13]:	dB/dt 198 microsecond time channel ($pV/A/m^4$)
SF[14]:	dB/dt 234 microsecond time channel ($pV/A/m^4$)
SF[15]:	dB/dt 281 microsecond time channel ($pV/A/m^4$)
SF[16]:	dB/dt 339 microsecond time channel ($pV/A/m^4$)
SF[17]:	dB/dt 406 microsecond time channel ($pV/A/m^4$)
SF[18]:	dB/dt 484 microsecond time channel ($pV/A/m^4$)
SF[19]:	dB/dt 573 microsecond time channel ($pV/A/m^4$)
SF[20]:	dB/dt 682 microsecond time channel ($pV/A/m^4$)
SF[21]:	dB/dt 818 microsecond time channel ($pV/A/m^4$)
SF[22]:	dB/dt 974 microsecond time channel ($pV/A/m^4$)
SF[23]:	dB/dt 1151 microsecond time channel ($pV/A/m^4$)
SF[24]:	dB/dt 1370 microsecond time channel ($pV/A/m^4$)
SF[25]:	dB/dt 1641 microsecond time channel ($pV/A/m^4$)
SF[26]:	dB/dt 1953 microsecond time channel ($pV/A/m^4$)
SF[27]:	dB/dt 2307 microsecond time channel ($pV/A/m^4$)
SF[28]:	dB/dt 2745 microsecond time channel ($pV/A/m^4$)
SF[29]:	dB/dt 3286 microsecond time channel ($pV/A/m^4$)
SF[30]:	dB/dt 3911 microsecond time channel ($pV/A/m^4$)
SF[31]:	dB/dt 4620 microsecond time channel ($pV/A/m^4$)
SF[32]:	dB/dt 5495 microsecond time channel ($pV/A/m^4$)
SF[33]:	dB/dt 6578 microsecond time channel ($pV/A/m^4$)
SF[34]:	dB/dt 7828 microsecond time channel ($pV/A/m^4$)
SF[35]:	dB/dt 9245 microsecond time channel ($pV/A/m^4$)
PLM:	Power line monitor

- Database A337_Waveform_F##.gdb in Geosoft GDB format, containing the following channels:

Time:	Sampling rate interval, 10.416 microseconds

Volt: Output voltage of the receiver coil (volt)

- Maps at 1:25,000 scale in Geosoft MAP & MapInfo TAB format, as follows:

A337_EMLog_Survey:	dB/dt profiles at a logarithmic scale for all survey lines E-W, time channels 0.10 – 9.24 ms
A337_Mag3:	Total magnetic intensity contours and colour image
A337_DEM:	Digital elevation model contours and colour image
A337_FP:	Flight path

- Google Earth file *A337_#_Final_Google.kml* showing the flight path of the block.

  Free version of Google Earth software can be downloaded from

  http://earth.google.com/download-earth.html

- An *A337_Readme.txt* file describing the content of digital data, as described above.

6. CONCLUSIONS

A helicopter-borne versatile time domain electromagnetic (VTEM) geophysical survey has been completed for IMX Resources NL, over their prospects located west-north-west of Devonport, Tasmania.

Total survey line coverage is 620.6 line kilometres. The principal sensors included a time domain EM system and magnetometer. Results have been presented as colour contour maps and off-set logarithmic profiles at a scale of 1:25,000.

Final data processing at the office of Geotech in Perth, Western Australia was carried out under the supervision of Stephen Carter, Processing Manager.

Simon Bailey
Geotech Airborne Pty. Ltd

APPENDIX A

SURVEY BLOCK LOCATION MAP

IMX Resources NL
Tasmania
VTEM Flight Plans
Google Earth™ Background
Geotech Airborne Limited

IMX Resources

21 February 2008

APPENDIX B

SURVEY BLOCK COORDINATES

(WGS84, UTM zone 55S)

BLOCK 1	
Eastings (X)	Northings (Y)
319195.86	5459472.95
321218.08	5455543.43
323922.87	5451770.35
326082.12	5447429.09
327382.84	5445570.92
324046.38	5443471.04
322887.86	5445278.33
318704.84	5448529.27
315948.58	5453403.99
314475.03	5456788.56

BLOCK 2	
Eastings (X)	Northings (Y)
322291.05	5484699.63
321519.07	5484747.14
320842.37	5486623.95
322341.79	5486600.00
323861.17	5486600.00
324623.09	5484869.21
325399.02	5484869.21
325399.03	5483482.41
322291.45	5483482.42

BLOCK 3	
Eastings (X)	Northings (Y)
349247.71	5471371.83
346567.02	5472937.64
348967.33	5476673.84
351648.01	5475108.03

BLOCK 4	
Eastings (X)	Northings (Y)
332378.50	5447256.39
329697.81	5448822.20
332098.10	5452558.39
334778.80	5450992.59

APPENDIX C

GENERALIZED MODELING RESULTS OF THE VTEM SYSTEM

Introduction

The VTEM system is based on a concentric or central loop design, whereby, the receiver is positioned at the centre of a 26.1 metres diameter transmitter loop that produces a dipole moment up to 625,000 NIA at peak current. The wave form is a bi-polar, modified square wave with a turn-on and turn-off at each end. With a base frequency of 25 Hz, the duration of each pulse is approximately 7.5 milliseconds followed by an off time where no primary field is present.

During turn-on and turn-off, a time varying field is produced (dB/dt) and an electro-motive force (emf) is created as a finite impulse response. A current ring around the transmitter loop moves outward and downward as time progresses. When conductive rocks and mineralization are encountered, a secondary field is created by mutual induction and measured by the receiver at the centre of the transmitter loop.

Measurements are made during the off-time, when only the secondary field (representing the conductive targets encountered in the ground) is present.

Efficient modeling of the results can be carried out on regularly shaped geometries, thus yielding close approximations to the parameters of the measured targets. The following is a description of a series of common models made for the purpose of promoting a general understanding of the measured results.

Variation of Plate Depth

Geometries represented by plates of different strike length, depth extent, dip, plunge and depth below surface can be varied with characteristic parameters like conductance of the target, conductance of the host and conductivity/thickness and thickness of the overburden layer.

Diagrammatic models for a vertical plate are shown in figures A and G at two different depths, all other parameters remaining constant. With this transmitter-receiver geometry, the classic **M** shaped response is generated. Figure A shows a plate where the top is near surface. Here, amplitudes of the duel peaks are higher and symmetrical with the zero centre positioned directly above the plate. Most important is the separation distance of the peaks. This distance is small when the plate is near surface and widens with a linear relationship as the plate (depth to top) increases. Figure G shows a much deeper plate where the separation distance of the peaks is much wider and the amplitudes of the channels have decreased.

Variation of Plate Dip

As the plate dips and departs from the vertical position, the peaks become asymmetrical. Figure B shows a near surface plate dipping 80º. Note that the direction of dip is toward the high shoulder of the response and the top of the plate remains under the centre minimum.

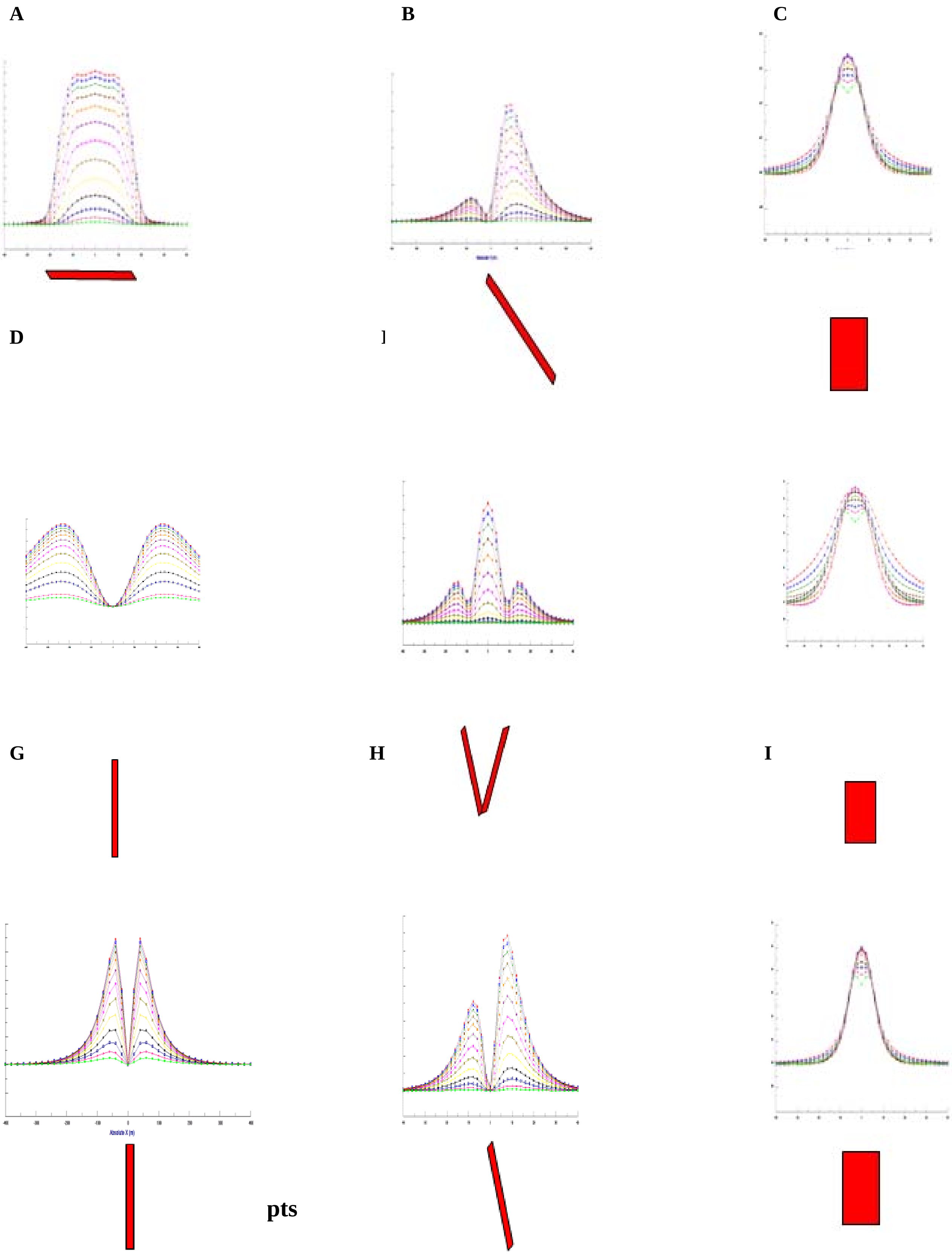
As the dip increases, the aspect ratio (Min/Max) decreases and this aspect ratio can be used as an empirical guide to dip angles from near 90º to about 30º. The method is not sensitive enough where dips are less than about 30º. Figure E shows a plate dipping 45º and, at this angle, the minimum shoulder starts to vanish. In Figure D, a flat lying plate is shown, relatively near surface. Note that the twin peak anomaly has been replaced by a symmetrical shape with large, bell shaped, channel amplitudes which decay relative to the conductance of the plate.

Figure H shows a special case where two plates are positioned to represent a synclinal structure. Note that the main characteristic to remember is the centre amplitudes are higher (approximately double) compared to the high shoulder of a single plate. This model is very representative of tightly folded formations where the conductors where once flat lying.

Variation of Prism Depth

Finally, with prism models, another algorithm is required to represent current on the plate. A plate model is considered to be infinitely thin with respect to thickness and incapable of representing the current in the thickness dimension. A prism model is constructed to deal with this problem, thereby, representing the thickness of the body more accurately.

Figures C, F and I show the same prism at increasing depths. Aside from an expected decrease in amplitude, the side lobes of the anomaly show a widening with deeper prism depths of the bell shaped early time channels.


A
B
C
D
G
H
I
pts

A set of models has been produced for the Geotech VTEM® system with explanation notes (see models A to I above). The reader is encouraged to review these models, so as to get a general understanding of the responses as they apply to survey results. While these models do not begin to cover all possibilities, they give a general perspective on the simple and most commonly encountered anomalies.

When producing these models, a few key points were observed and are worth noting as follows:

- For near vertical and vertical plate models, the top of the conductor is always located directly under the centre low point between the two shoulders in the classic **M** shaped response.

- As the plate is positioned at an increasing depth to the top, the shoulders of the **M** shaped response, have a greater separation distance.

- When faced with choosing between a flat lying plate and a prism model to represent the target (broad response) some ambiguity is present and caution should be exercised.

- With the concentric loop system and Z-component receiver coil, virtually all types of conductors and most geometries are most always well coupled and a response is generated (see model H). Only concentric loop systems can map this type of target.

The modelling program used to generate the responses was prepared by PetRos Eikon Inc. and is one of a very few that can model a wide range of targets in a conductive half space.

General Interpretation Principals

Magnetics

The total magnetic intensity responses reflect major changes in the magnetite and/or other magnetic minerals content in the underlying rocks and unconsolidated overburden. Precambrian rocks have often been subjected to intense heat and pressure during structural and metamorphic events in their history. Original signatures imprinted on these rocks at the time of formation have, it most cases, been modified, resulting in low magnetic susceptibility values.

The amplitude of magnetic anomalies, relative to the regional background, helps to assist in identifying specific magnetic and non-magnetic rock units (and conductors) related to, for example, mafic flows, mafic to ultramafic intrusives, felsic intrusives, felsic volcanics and/or sediments etc. Obviously, several geological sources can produce the same magnetic response. These ambiguities can be reduced considerably if basic geological information on the area is available to the geophysical interpreter.

In addition to simple amplitude variations, the shape of the response expressed in the wave length and the symmetry or asymmetry, is used to estimate the depth, geometric parameters and magnetization of the anomaly. For example, long narrow magnetic linears usually reflect mafic flows or intrusive dyke features. Large areas with complex magnetic patterns may be produced by intrusive bodies with significant magnetization, flat lying magnetic sills or sedimentary iron formation. Local isolated circular magnetic patterns often represent plug-like igneous intrusives such as kimberlites, pegmatites or volcanic vent areas.

Because the total magnetic intensity (TMI) responses may represent two or more closely spaced bodies within a response, the second derivative of the TMI response may be helpful for distinguishing these complexities. The second derivative is most useful in mapping near surface linears and other subtle magnetic structures that are partially masked by nearby higher amplitude magnetic features. The broad zones of higher magnetic amplitude, however, are severely attenuated in the vertical derivative results. These higher amplitude zones reflect rock units having strong magnetic susceptibility signatures. For this reason, both the TMI and the second derivative maps should be evaluated together.

Theoretically, the second derivative, zero contour or colour delineates the contacts or limits of large sources with near vertical dip and shallow depth to the top. The vertical gradient map also aids in determining contact zones between rocks with a susceptibility contrast, however, different, more complicated rules of thumb apply.

Concentric Loop EM Systems

Concentric systems with horizontal transmitter and receiver antennae produce much larger responses for flat lying conductors as contrasted with vertical plate-like conductors. The amount of current developing on the flat upper surface of targets having a substantial area in this dimension, are the direct result of the effective coupling angle, between the primary magnetic field and the flat surface area. One therefore, must not compare the amplitude/conductance of responses generated from flat lying bodies with those derived from near vertical plates; their ratios will be quite different for similar conductances.

Determining dip angle is very accurate for plates with dip angles greater than 30º. For angles less than 30º to 0º, the sensitivity is low and dips cannot be distinguished accurately in the presence of normal survey noise levels.

A plate like body that has near vertical position will display a two shoulder, classic **M** shaped response with a distinctive separation distance between peaks for a given depth to top.

It is sometimes difficult to distinguish between responses associated with the edge effects of flat lying conductors and poorly conductive bedrock conductors. Poorly conductive bedrock conductors having low dip angles will also exhibit responses that may be interpreted as surfacial overburden conductors. In some situations, the conductive response has line to line continuity and some magnetic correlation providing possible evidence that the response is related to an actual bedrock source.

The EM interpretation process used, places considerable emphasis on determining an understanding of the general conductive patterns in the area of interest. Each area has different characteristics and these can effectively guide the detailed process used.

The first stage is to determine which time gates are most descriptive of the overall conductance patterns. Maps of the time gates that represent the range of responses can be very informative.

Next, stacking the relevant channels as profiles on the flight path together with the second vertical derivative of the TMI is very helpful in revealing correlations between the EM and Magnetics.

Next, key lines can be profiled as single lines to emphasize specific characteristics of a conductor or the relationship of one conductor to another on the same line. Resistivity Depth sections can be constructed to show the relationship of conductive overburden or conductive bedrock with the conductive anomaly.

APPENDIX D

VTEM WAVE FORM